ICSAT

DESIGN & TECHNOLOGY

USING PAPER & BOARD FOR KS1, 2 & 3

A TEACHER'S HANDBOOK FOR THE NATIONAL CURRICULUM

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Symbols used in the book:

Signposting to aid progression

Curriculum links indicated by the jigsaw icon

Supporting materials can be found on the accompanying CD

4. Paper + Board Materials

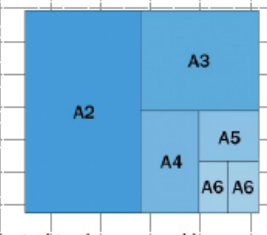
Paper is made from wood pulp which are fine vegetable fibres, these fibres are called cellulose and are most often extracted from wood of the the coniferous variety. The wood is chipped and pulped to provide the raw material. It is then cooked in water with bleach and bonded with clay and or chalk and filtered on a fine mesh screen. Clays and chalks create an opacity of the paper. The cellulose fibres naturally bond as the water drains away. In commercial paper production because of the vigorous manipulation of the pulp the fibres tend to lie in one direction as in the original timber and this direction is called the grain. In hand made papers this is not so due to the lack of vigorous agitation. This cellulose blanket is rolled (calendars) to remove the remaining water and make the bond stronger. Paper making uses a very large quantity of water in the production process, however new legislation requires that 90 per cent has to be recycled. The dried paper is wound onto large rolls called webs. When required the paper unrolled and cut to size.

Some large commercial printing and packaging companies work directly from the rolls, this is called web fed. Other companies work from the flat sheets the largest usually available is 4AO. Paper can not be recycled indefinitely as the fibres get shorter and fail to bond together. Most paper manufacturers use a mixture of new wood chippings and recycled paper to make the pulp.

Paper and board contaminated by food can not be recycled due to the fibres absorbing the grease from the food.

Stock sizes of paper and board.

Paper and board are available in a large range of sizes and thickness, in this country we adopted the metric system of classification back in 1971. The surface size of paper is classified by the letter A and a number. The normal size of copy paper is A4. Paper twice the size of A4 is A3 and twice the size again is A2, then A1 and A0 which is the largest size commonly available. Some specialist papers are available up to four times the size of A0 and designated 4A0 about the size of a double bed duvet cover.



The thickness of paper is measured by weight. The weight of the paper is indicated to the user and is expressed in grams (gsm) per square metre often abbreviated to gsm/m2 or just g. A square metre of copier paper will weigh 80 grams and will be designated as A4 80g. Paper greater than 200g is recognised as board and classified as such. The thickness of board is expressed in microns, one micron is one thousandth of a millimetre therefore 2 millimetre thick board is 2000 micron.

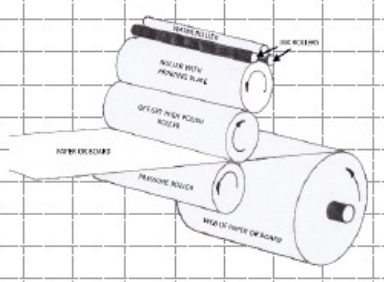
Some companies who are manufacturing large quantities of packaging such as cereal boxes may specify board to be of a particular width and delivered on a web (roll). This will be a calculated size to enable the company to print and die-cut the packaging with as little waste as possible. By fitting together the packages to create little waste this activity is called tessellation. Commercial waste is weighed and although recycled, tax is paid on this waste.

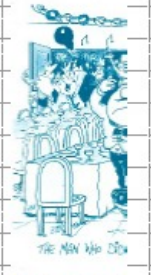
Packages tessellated.

6. Printing

Lithography is the most common large scale commercial printing process. It involves printing the four Process Colours, cyan, magenta, yellow and black, usually referred to as CMYK where black is K printed last of the four colours and Keys the other colours together. Other colours such as greens, purples and brown/oranges are produced by over laying the four CMYK colours in different proportions.

The base of lithography is that oil and water do not mix. On treated photo plates of the image to be printed the oily ink sticks to the image and the non image areas are kept damp thereby repelling the ink. The process is often referred to as off-set litho, as the photo image is printed to a highly polished roller which then transfers the image to the material. The material does not come in contact with the photo plate the image is off-set. Lithography produces a very high quality image not only on paper and board but also on metal, an example is on drinks cans. Lithography can not be replicated in schools.





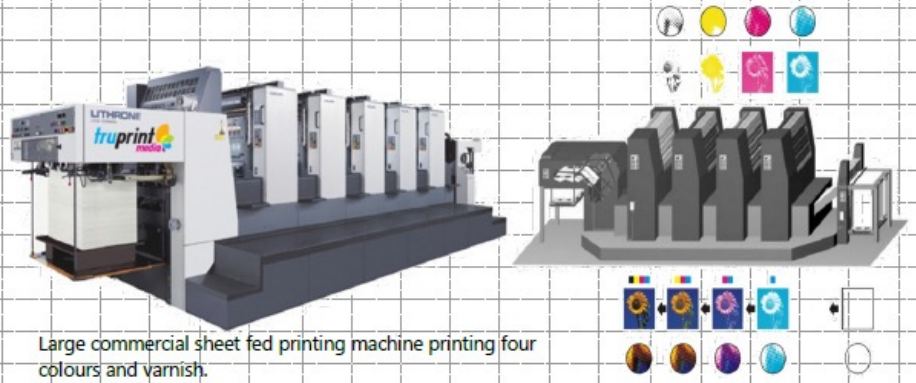
Cyan printed

Magenta printed

Yellow printed

Black or key printed

All colours printed



Large commercial sheet fed printing machine printing four colours and varnish.

11. Found materials

At the outset it is important to say that all the found materials that we have available to our children are safe and clean, if in doubt bin. We collect them in the staff room in a designated box and our adults bring in all manner of items for which we are always grateful.

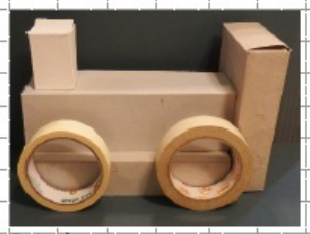
Most domestic card packages which are not contaminated by food and grease such as Smarties tubes, kitchen roll cores, cereal boxes, cosmetic boxes, and clean ice-cream tubs. Card packaging when turned inside out and re-glued can be stored flat and added to the rummage box as needed.

In KS 3 when design contexts are more open each child could be tasked to supply a plastic container for example to be used as a shade/diffuser for a 10 mm LED as part of the creation of a desk lamp. It is not sensible to list all the suitable finds but our photographs throughout the book will give you ideas.

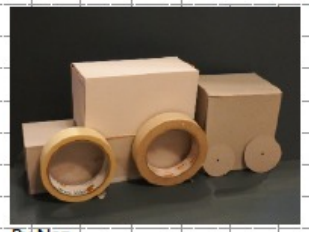
What will we use found materials for.

- Found materials can be used as the final construction material either because in KS 1 and KS 2 skills have not been developed to reproduce the shapes for example the tissue box as a mood light, or no other material is available.
- Found materials can be assembled to stimulate thinking.

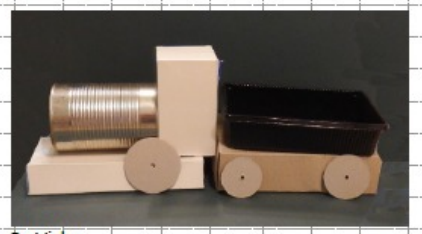
Pencil box made from spiral wound tube



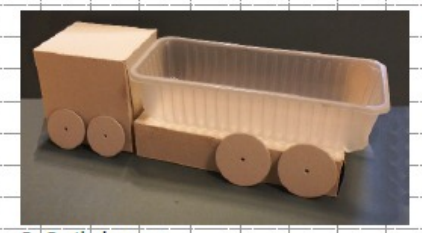
By Leah



By Naz



By Vicky



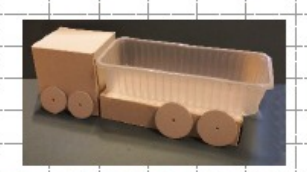
By Bartholomew

3S's
It is useful to think that you are designing:
Something for...
The product
The end user

15. Card Engineering

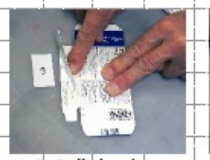
Often construction in Primary Schools starts by combining discarded card boxes. These are then treated to a coat of powder paint. Better results can be obtained if help can be had to turn the boxes inside out and re-glued. The paint will coat much better on the non-printed surface and be more aesthetically acceptable. We know this is just another job but the end result is worth it. Later in the Key Stages card boxes may form the base of ideas, they may fire the imagination of children.

When we painted we selected a light colour to try to cover a dark colour on the box as we can not prejudge what colours children will choose this proved to be a real indicator that the boxes need to be turned..



1. Original box

2. Original box painted (not a good look)

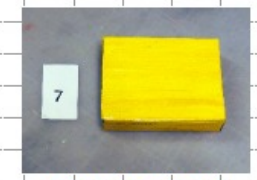


3. Splitting box apart with finger

4. Refolding the box

5. Re-creasing the box

6. Re-glued box



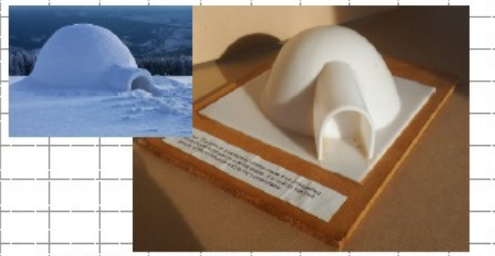
7. Painted box (much better look)

The photograph below shows common household packaging deemed to be useful for modelling in Primary and for placing together to stimulate thinking in latter KS 2 and in KS 3.

This photograph shows the same packages turned inside out and re-glued ready for use by children

18. Structures

Models we have collected to show our children how shelters can differ but all show how the strength in a structure is achieved. There is triangulation in the bivouacs, the tee-pee and yurt and aspects of a dome in the igloo and the Anderson shelter.



The Yurt is native to Mongolia and the northern region of China. It is a mobile home in that it is dismantled and and transported to a new site by the nomadic people.

The igloo is a temporary home found in the very most northern regions of Canada and Alaska and is constructed from snow blocks. Being dome shaped it is extremely strong.

A tepee or teepee is triangular prism of varying numbers of sides and is a creation of the North American Indians. The various tribes used slightly different constructions. The tepee is transportable.

The Anderson shelter was developed in World War 2 in response to bombing raids over Britain. They were often cited in peoples gardens and were a corrugated steel arched construction bolted together and covered by a meter layer of soil and turf creating an underground bunker.

A bivouac is a temporary shelter usually created in wooded areas and nearly always is triangular in elevation and in plan. In the two photographs we see one made from natural material gathered on site and a second made from sheet material brought to site.

19. Unusual uses of Paper + Board

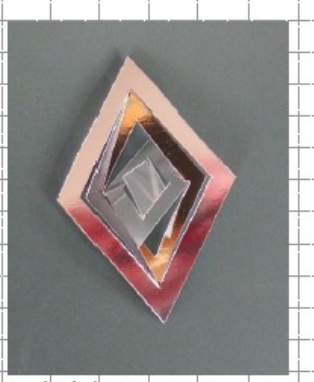
Cup cakes made for a display using 220 gsm board of different colours and embellished.

Chip cone

Construction vehicles made from a commercial kit.

Life size sculptured cavern construction using only corrugated board by Eva Jospin.

Card creatures made from a commercial publication over a holiday by Jose



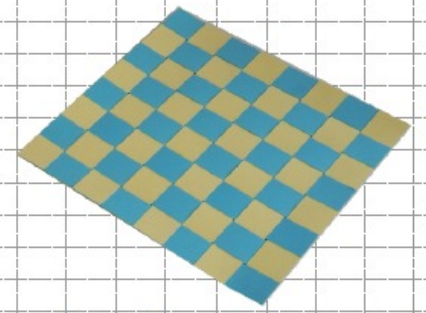
Card spiral. A prototype for a Christmas tree decoration. It would also be a possibility for an item of jewellery.

Card Ukulele. Using one of ICSATs die-cut boxes and a card tube from aluminium kitchen foil.

Appendix 4 – Gallery

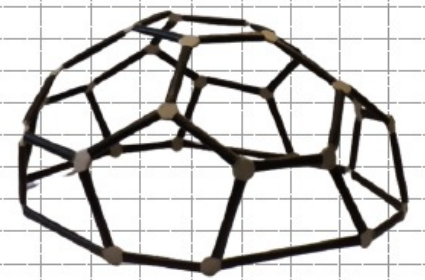
The following photographs are used on the book cover.

A hollow letter made from mount board (blue on white) with a gold face punched in seven places to take LEDs. Contains a 3v battery pack.



Strips of 120 gms paper woven to create a chequer board which can then be glued to a heavier weight board.

Product modelled in found corrugated board using a bottle top as a knob.



A geodesic dome built using drinking straws cut only to two lengths and using our two specially developed card joining pieces. This was developed to use with year 5 children as a FPT prior to a Shelters project.

A Jack in the Box using an ICSAT die-cut box and a child made "Jack" and Chinese spring. The development was aided by using a found box initially to do trials with.

Other ICSAT books

Design and Technology KS2

ISBN: 978-1-3999-1153-5

This book covers all the key knowledge required for KS2 D&T, it is aimed at teachers who are just getting started with D&T or those who are looking to improve their knowledge and skills. Clear text and well illustrated reference book that is handy to have nearby.

Supplied with a CD that contains additional supporting materials.

It does not include Food.

Design and Technology KS2

ISBN: 978-1-3999-2531-0

This book covers all the key knowledge required for KS1 D&T, it is aimed at teachers who are just getting started with D&T or those who are looking to improve their knowledge and skills. Clear text and well illustrated reference book that is handy to have nearby.

Supplied with a CD that contains additional supporting materials.

It does not include Food.

Programming and Embedded Systems

ISBN: 978-1-3999-3482-4

This book introduces programming, the supporting electronics required for KS2, covering basic systems, microcontrollers, programming methods, how to design an embedded system, what commands do what, how to get started, along with 7 working projects each one with MicroBit, Crumble, Pixie:8 (Picaxe & Genie), Raspberry Pi Pico and Arduino solutions.

Supplied with a CD that contains additional supporting materials and code.